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Journal of the Missouri Native Plant Society

GUEST EDITORIAL NEEDED—A NEW LEVEL OF ENVIRONMENTAL CONSCIOUSNESS!

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Editors' note: Most Missouri Native Plant Society members will recognize the name Mervin Wallace as a naturalist of note, pioneering Missouri natives nurseryman, and all around native plant guru. The following editorial is adapted with permission from the introduction to Merv's 1994 Catalog. We invite anyone interested to write for a copy of the original.

1993 was a year of environmental awakening for me. I'm not talking about recycling the trash. We already do that. Not fossil fuel consumption either. I'm so conservative I've been buying fuel efficient cars forever. I did pay more attention to the solar powered race in Australia this year and I did ponder the environmental consequences of spilling some oil on the ground near my well. You can't listen to a news broadcast or read a paper without hearing or reading something about the environment. Environmental consciousness seems to be the wave of the '90s.

But my great revelation didn't come from the media. It came from several years of chasing all over the state looking for wildflower seeds to collect in quantities larger than a few handfuls. It is incredible how little remains of the native plant diversity that was here before European settlement. Part of my awareness came after arriving at Springfield to collect seed from a half-acre solid stand of prairie blazing stars only to find that it had been mowed down. The land owner had promised not to mow it unless the city made him comply with the weed ordinance.

I received another jolt when I traveled to the Branson area this year to collect seed from a bald knob (glade) I frequent. This 110 acres of intact plant community, comprising more than 200 native species, probably has less than two years to exist before it is converted to buildings, parking lots, Bermuda grass, and palm trees. The realization is devastating to me. The developer will see low-life weeds where I see a large plant community that has existed for thousands of years. The land was still for sale in Nov. '93. Nice location for a single family dwelling with established wildflowers all around or a fabulous music theater.

So how do we turn this decline of plant diversity into something positive like recycling? Granted, there are some large chunks of native plant communities being managed for their biodiversity by federal, state, and private organizations, but those amount to a very small percent of the state's land, and there are many miles of privately owned land in between. There are small populations of native plants all over the state on private land and some scattered large ones like the glade near Branson. We need to step to a new level of environmental awareness, one that puts biodiversity foremost in our minds when we do anything affecting plant life on our property. Preserving pockets of diversity needs to be the environmentally correct thing for all land owners, devel-opers, and landscape architects to do. We need to realize that we can coexist with native plants growing on at least part of our land. Even parts of the Branson glade can be left in the landscape if planning and development are done with an environmental consciousness. Native plants are not life forms that must be eradicated to make the premises look more controlled.

There are existing pockets of diversity on almost every property. These may range from a few square feet to many acres, and include the most diverse part of a woods, a rocky opening in a woods or field (glade), part of a fence row with many native grasses and flowers, an area under a power line where occasional disturbance

has kept diversity high, a corner of a lot, or a prairie remnant. A pocket consisting of a handful of native plants is worth saving no matter what the size, but particularly when it's a half acre of blazing stars in an area that was once prairie as far as the eye could see.

If you have a pocket of native plants, you have an historical treasure. You can take pride in knowing your pocket of diversity has survived the past few hundred years of settlement. Consider it an antique that needs your help to make it through the coming hundreds of years. You can't surround it with a glass case and stand back to admire it though, or its diversity will deteriorate. A total lack of management will likely result in the loss of species from your area. You will have to learn how to provide disturbances similar to the presettlement disturbances that kept the diversity of native flora near its maximum. The knowledge exists. If you will give me a call I will be glad to give advice, but you can also learn by visiting federal and state owned lands. Tell their land managers you want to maximize biodiversity on your property. A good place to start would be with a naturalist at a state park or Conservation Department nature center.

So you live on a lot in an urban area where the total number of plant species is about five, none of which is native, and they've all been genetically altered to make you feel needed. They need you to feed and water them and worry about them when the weather gets a little extreme. The Missouri Native Plant Society can provide you with a list of native plant and seed sources. These can provide you with a pocket of diversity, either seeds for prairie and glade plantings, or plants for use in beds and naturalizing in low use, low maintenance areas. It won't be the same thing as having an original, but your planted pocket along with its associated native butterflies, birds, and other wildlife will provide years of enjoyment. It won't be no maintenance, but you will need to spend only a few minutes per year, compared to the hours spent on the lawn. And you won't need to spend large sums of money on health bills for your pocket of

diversity. Native plants seldom have health problems and tend to look better when they haven't "bulked-up" on chemicals.

ANNOUNCEMENT

Copies of plant lists and other information relating to the flora are requested for inclusion in the Society's flora file. Please send items to the archivist, Jim Bogler (see address on inside front cover).

CARYA PALLIDA, A NEW HICKORY FOR MISSOURI

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Sand hickory, *Carya pallida* (Ashe) Engl. & Graebn., is a widely distributed tree in the southeastern United States, reaching its northern range limit in southern New Jersey. It grows on dry, often sandy soils, and is seldom abundant over much of its range. Sometimes called pale hickory, *Carya pallida* has tight bark, typically seven leaflets per leaf, and silvery scales on the lower leaflet surfaces giving them a pale appearance.

Although reported from three southwestern Illinois counties (Mohlenbrock, 1986) and from Poinsett County in northeastern Arkansas (Heineke, 1984), this species has not been documented from Missouri previous to this report. The Arkansas record was the first report of sand hickory from west of the Mississippi River.

I collected two specimens of sand hickory in Scott County, Missouri, in June, 1992. Both trees were growing in a sandy-soiled woodland about three miles Southeast of Bounden. They were 3-5 inches dbh and 25-30 feet tall. The site is one of a number of occurrences of the Scotco soil series that consists of deep, excessively drained, sandy, alluvial sediments (Festervand, 1981). On subsequent visits to sandy-soiled sites in southeastern Missouri, in July 1992 and May 1993, I documented the occurrence of sand hickory in three additional Scott County sites and at three sites in Stoddard County.

Representative Collections: MISSOURI. Scott County, ca 3.0 mi SE of Bounden (T28N R14E S28 SE¼ SW¼), Lowlands Section of Mississippi Lowlands Natural Division, locally common in sandy woodland in sand prairie/savanna/woodland complex. 5 June 1992, *Smith 3175* (MO). Stoddard County, ca. 4 mi NNE of Dexter

(T25N R10E S1 NE¼ NE¼), Crowley's Ridge Section of Mississippi Lowlands Division, Holly Ridge Conservation Area, upper edge of sand/gravel pit at edge of forested area, 14 May 1993, *T. Smith, & S. Holmes 3207* (MO).

Sand hickory seems to intergrade with the black hickory, *Carya texana* Buckley, in southeast Missouri and southern Illinois. Pignut hickory, *Carya glabra* (Mill.) Sweet, also occurs in the vicinity of sand hickory, and the two species may hybridize (pers. comm. Stone 1993). These hickories are difficult to distinguish at the southeastern Missouri sites, with the abundance of silvery scales on the lower leaflet surfaces of sand hickory being the most useful field character. The scales are most abundant early in the growing season. Sand hickory usually has a more densely pubescent leaf rachis than does black hickory, with the hairs concentrated adaxially near the insertion of the leaflets.

Although the abundance of sand hickory in Missouri is not yet known, it seems likely that this tree may merit state rare status, since its occurrence is probably restricted to southeast Missouri's deep, sandy, alluvial deposits, many of which have been cleared for agricultural use.

The assistance of Dr. Donald Stone of Duke University in confirming the collected specimens is gratefully acknowledged.

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Haller, Karen S. 1994. Walking With Wildflowers. A Field Guide to the St. Louis Area. University of Missouri Press, Columbia, MO. 240 pp. ISBN 0-8262-0950-5. Paperbound. [to be reviewed next issue]

NEMO HERBARIUM: HISTORY AND PRESENT STATUS

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The herbarium (NEMO) of Northeast Missouri State University (NMSU) originated from botanical collections gathered during vacations by students of the First District State Normal School (Kirksville, MO), founded in 1867. These were stored in a small laboratory, known as the cabinet room or museum, east of the chapel on the school's second floor (Violette, 1905).

In 1906, Science Hall was completed and was connected to the west side of the original structure. This new building burned in 1918 from a fire of "mysterious origin" that resulted in the loss of most of its furnishings and equipment (Simmons, 1927). Science Hall was reconstructed, and a fire door in the connecting corridor saved it from a later fire (1924) that destroyed the adjacent Baldwin Hall and Library Building (Ryle, 1972).

In 1947, the Northeast Missouri State Teacher's College (NMSTC, having been renamed in 1919) purchased the herbarium (along with library holdings and other science supplies and specimens) of Central Wesleyan College (CWC) for $4000 (Hake, 1974). The college, a private Methodist liberal arts institution in Warrenton, Missouri, had closed in 1941 due to financial difficulties (Wolff, 1957). Its herbarium contained approximately 1000 plants, collected primarily during the 1930s, though the oldest specimens date from 1875 (Daniels, 1983).

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An important collector for the CWC herbarium was John H. Frick (1845-1927), one of the college's first two graduates (1870) and professor of natural science and math, who conducted several expeditions to the Rocky Mountains (Schoenig, 1906). His son, F. William Frick, who graduated from CWC in 1894 (Peithman, 1975), also contributed specimens, as well as William A. Sauer, professor of French and music, who had an interest in botany (Kenzer, 1987). The herbarium at CWC was studied and annotated by Dr. Julian Steyermark in 1934, prior to his publication of his *Spring Flora of Missouri* (Steyermark, 1940).

At NMSTC, the CWC collection was stored in boxes on the third floor of Science Hall. It was first curated by Dr. Max Bell, a botanist hired in 1954, who placed family names on the specimens and stored them in a wooden cabinet.

In 1955, the Science Division moved from the old Science Hall (renamed Laughlin Hall) to a newly constructed Science Hall that it occupies at present. The east wing of the new building included a room (SH 245) designed especially to house the herbarium, initially contained in a single metal cabinet.

Additional specimens were acquired by purchase from the General Biological Supply Company (Chicago, IL) and from the personal collections of Dr. Bell and Dr. Dean Rosebery (Science Division head). When Dr. Melvin Conrad (curator, 1967-1991) was hired the collection totalled ca. 1853 sheets. He was requested to fill two other herbarium cabinets that had been bought.

During the expansion of the collection, emphasis was placed on the flora of northeast Missouri. Although Dr. Conrad was the principal collector, other significant contributors included David Broyles (1981-1984, 1990), Yuki Gleason (1988), Ernest Palmer (1919-1927, 1949-1959), Julian Steyermark (1951-1956), Randy Walker (1979-1983), and Tom Welton (1982). Numerous specimens have been received through exchange with the University of Missouri, Columbia (1894 sheets) and the

Missouri Botanical Garden, St. Louis (1182 sheets), as well as the Carnegie Museum, Pittsburgh (409 sheets), University of Illinois, Urbana (265 sheets), Moberly Jr. College, Missouri (103 sheets), and Miami University, Oxford, Ohio (100 sheets).

Starting in 1969, when the holdings totalled 3790 specimens, each sheet was assigned an accession number. For the next two decades, the herbarium grew at an average rate of about 743 accessions per year (Fig. 1).

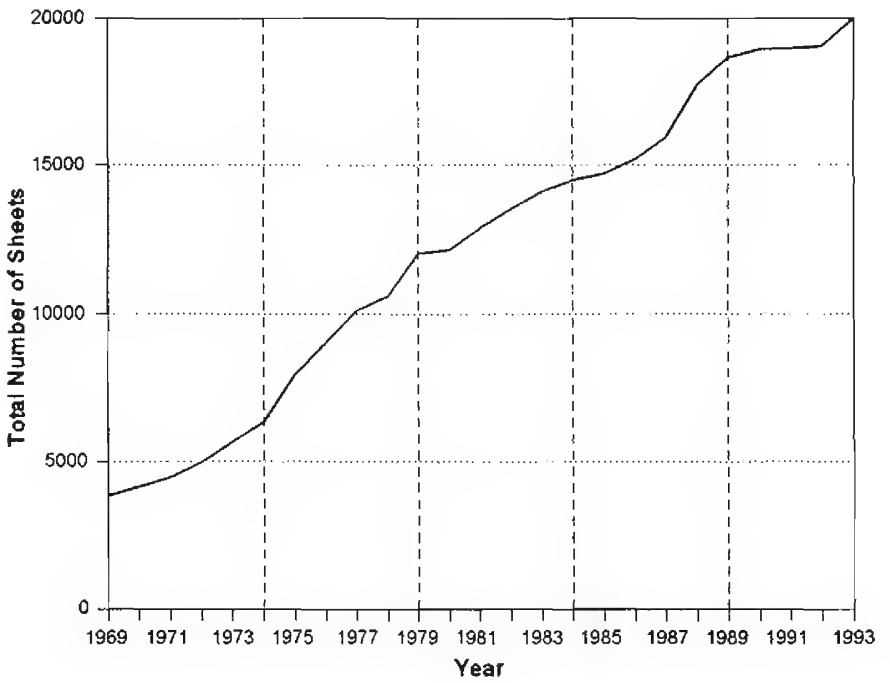

Figure 1. The number of specimens accessioned at NEMO.

To accommodate the growing collection, six new herbarium cases were purchased in 1970. In 1972, 12 used cases were obtained from the Missouri Botanical Garden for $30 each. Six more cases have subsequently been added (two in 1987, and three in 1992). One was donated in 1980 by the Associated Electric Cooperative,

Inc. (Springfield, MO) to hold voucher specimens from the Prairie Hill Mine area (see below).

The acronym *NEMO* first appeared in the eighth edition of the *Index Herbariorum* (Holmgren et al., 1990). Dr. Conrad retired in 1991 and was replaced as curator by Dr. Donna Ford.

To aid research, service and teaching, a project to create a computerized specimen database was begun in 1992. By 1993, all Missouri monocotyledon collections were entered into the database and work on Missouri dicotyledons was initiated. This process also includes updating nomenclature to conform with that found in the *Catalogue of the Flora of Missouri* (Yatskievych & Turner, 1990).

PRESENT STATUS OF THE HERBARIUM

In April 1994, NEMO contained 20,544 plant specimens, making it the seventh largest of 39 herbaria in Missouri (Hunt et al., 1987). The majority of collections

Table 1. Taxonomic Diversity represented in the NEMO herbarium by major groups of plants.

Plant Group	Number of Families	Number of Genera
Non-vascular Plants		
Lichens	12	21
Bryophytes	79	152
Total	91	173
Vascular Plants		
Pteridophytes	27	56
Gymnosperms	10	25
Monocots	33	119
Dicots	164	1077
Total	234	1277

are of angiosperms (Fig. 2), numbering ca. 14,000 dicotyledon and 3000 monocotyledon accessions. The gymnosperms (190 sheets), pteridophytes (460 specimens) and non-vascular plants are also represented in the holdings. The bryophytes and lichens include nearly 3000 collections. Algae (35 specimens) and fungi (ca. 575 species) are unaccessioned at present.

The family filing sequence follows Engler and Diels (1936) for spermatophytes and Lellinger (1985) for pteridophytes, with lower taxa arranged alphabetically within each family. The taxonomic representation of vascular plants in the collection includes over 200 families, nearly 1300 genera and more than 4000 species (Table 1). There is a specimen from each of the Missouri families except three (Leitneriaceae, Pedaliaceae, and Thymelaeaceae). Non-vascular plants comprise ca. 90 families, about 175 genera and nearly 300 species (Table 1).

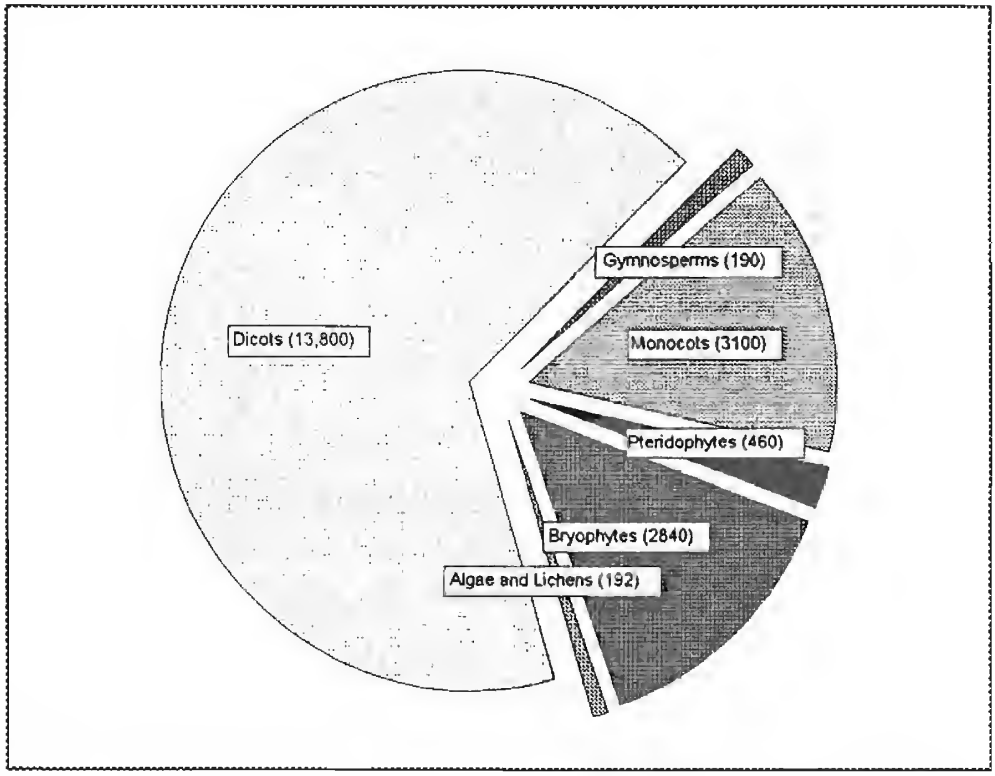

Figure 2. Taxonomic distribution; the number of collections in the NEMO Herbarium by plant group.

Over half of the collections are from Missouri, with California, Georgia, and Florida also well-represented (Table 2). There is a specimen from all but two of the states (Delaware and New Hampshire). Collections from foreign countries, principally Mexico, represent over 5% of the holdings (Table 2). Other localities include Brazil, Canada, Chile, China, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Israel, Jamaica, Nicaragua, Peru, Panama, and Venezuela.

Notable collections at NEMO include more than 1000 plants from a 1973 expedition in the western United States by Dr. Conrad and Dr. David Dunn. Much Georgia material was collected in the 1960's by Dr. Conrad as a student and brought to NMSU when he joined the faculty. Numerous Florida specimens were obtained from a field study course conducted by Dr. Bell from the late 1950s through 1978.

Other specimens of special interest are ca. 475 *Lupinus* sheets (116 taxa) collected by Dr. Conrad during his dissertation studies (1973-1980). Vegetational survey

Table 2. Geographic Distribution: Major Localities. The state or country of 13,526 specimens was recorded.

State/Country	Number of Specimens	Percent of Total Collection
1. Missouri	7190	53.1%
2. California	1055	7.8%
3. Georgia	914	6.8%
4. Mexico	553	4.1%
5. Florida	508	3.8%
6. North Carolina	329	2.4%
7. Alaska	285	2.1%
8. Washington	254	1.9%
9. Colorado	237	1.8%
10. Oregon	208	1.5%
11. Brazil	198	1.5%

collections include plants from the Prairie Hill Mine Area (Randolph County, MO; Dimit et al., 1980) and from the Little Chariton River (Chariton County, MO; Kangas & Conrad, 1985). NEMO also houses voucher specimens for over 825 new county records of taxa from 26 counties (Table 3; reported periodically in *Missouriensis*), one moss co-type (*Physcomitrium collenchymatum* Gier), and one Asteraceae isotype (*Machaeranthera ammophila* Reveal). The collection has been consulted for the Missouri Natural Heritage Program and contains several rare plant specimens.

The NEMO staff consists of a faculty curator and undergraduate assistants who perform various duties such as mounting specimens, entering label information into the database, and filing sheets. The herbarium functions as a resource for students in introductory biology, general botany, plant taxonomy, local flora,

Table 3. Numbers of County Record Vouchers at NEMO.

County	Specimens	County	Specimens
Adair	276	Camden	4
Randolph	212	Chariton	3
Sullivan	75	Gentry	3
Clark	55	Oregon	2
Schuyler	52	Scotland	2
Knox	38	Douglas	1
Macon	28	Harrison	1
Crawford	25	Johnson	1
Lewis	20	Marion	1
Iron	9	Putnam	1
Shannon	6	Reynolds	1
Monroe	5	Saline	1
Phelps	5	Worth	1

plant morphology, plant anatomy, and ecology classes. The facility is also used by the Missouri Departments of Conservation and Natural Resources, other universities, area high schools, community organi-zations, and local citizens. The collection is open to anyone interested in studying the specimens. For more information contact Dr. Donna Ford, Division of Science, Northeast Missouri State University, Kirksville, MO 63501 (816)785-4623.

ACKNOWLEDGMENTS

We are most appreciative for the assistance provided by the Special Collections staff at the NMSU Pickler Memorial Library in consulting the CWC Archives. We thank Dr. Melvin Conrad and Dr. Max Bell for their gracious consent to supply information in personal interviews.

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MENYANTHES TRIFOLIATA REDISCOVERED IN MISSOURI

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A new location for *Menyanthes trifoliata* L. var. *minor* Raf. (Menyanthaceae) was discovered in Reynolds County during recent field studies as part of the Missouri Natural Features Inventory (Ryan, 1992). Voucher specimens were collected on 11 August 1992 (*Ryan 2062*, MO) and 28 August 1992 (*Ryan 2098*, UMC). This species, commonly known as bogbean or buckbean, was previously known in Missouri from only one site along the North Prong of Bee Fork, also in Reynolds County. The original location was discovered by Julian Steyermark in 1936, and he revisited the site several times prior to the publication of his floristic manual (Steyermark, 1963). However, by the time Steve Orzell performed his inventory of selected Missouri fens (Orzell, 1982a, b, 1983), this station had undergone significant alterations, including draining of the area's wetlands, and the species was not observed. Subsequent visits since that time by other botanists have also failed to locate the species there. The species was previously listed as Endangered by the Missouri Natural Heritage Program (Missouri Department of Conservation, 1974), but was reclassified to Possibly Extirpated and then Extirpated (Missouri Department of Conservation, 1984, 1991) after the failed attempts to locate an extant population.

At the new Reynolds County site, bogbean occurs in Maury Pond, a small, upland sinkhole pond. The site is about 1 airmile west of State Route 21 and 3.5 airmiles north of Ellington on the east side of a dirt county road running through Dry Valley (T30N R01E NE¼ of SW¼ of SW¼ of Sec. 07). The location is named on the Redford 7.5 Minute U.S.G.S. Quadrangle, and occurs about half-

way up a steep, north-facing slope. The pond is choked with vegetation and can be classified as containing a pond shrub swamp community (Nelson, 1987). Plants are common in two portions of the pond: between hummocks of grasses, sedges, and *Cephalanthus occidentalis* in a ring of shallow (to ½ meter deep) water; and on a quaking mat composed primarily of *Dulichium arundinaceum* and a *Sphagnum* species that occupies the center of the pond. Other common associates include *Triadenum walteri, Lycopus rubellus,* and *Juncus torreyi.* The land is privately owned by an out-of-state corporation, and the quarter-section containing the pond was clear-cut within the past decade. No short-term adverse effects to the pond were observed, but it remains to be seen whether any significant increase in sedimentation occurs in the pond as a result of this timber harvest. Efforts are being initiated by the Missouri Department of Conservation to inform the landowner of the significance of this site.

The communities in which the two Missouri populations have been found are quite different. Steyermark's site along Bee Fork was originally described as a calcareous bog (Steyermark, 1963), but has been interpolated to be a fen, which has very different hydrology, alkalinity levels, and associated vegetation than the sinkhole pond station found in 1992. Fens are wetlands created by alkaline seepage of usually permineralized water, which moves through the site, albeit slowly, and they have a characteristic flora composed of species able to grow in soils inundated by this mineral-rich, high pH water. In contrast, sinkhole ponds are karst features, created by the partial collapse of limestone caverns beneath a site. Most sinkholes, including Maury Pond, are not fed by springs or seepage, and are instead standing-water sites formed from the collection of rain water. Although the underlying bedrock of sinkhole ponds is usually limestone or dolomite, the thick layer of decaying organic debris that slowly accumulates to fill in these depressions creates acidic soils that characteristically harbor

plant species quite different from those growing in fens. Orzell (1982a, b, 1983) was unable to find this species in any of the 160 fens he surveyed during his study. It may be, however, that botanists have been searching in the wrong kind of habitat for this species. Elsewhere, the plant is characteristically found in acidic wetlands, such as bogs, but it has been collected at some freshwater marsh sites as well (Gleason and Cronquist, 1991). With the discovery of a sinkhole population, many other similar sites should be checked for additional populations.

Gleason and Cronquist (1991) reported the range of this species as Europe and boreal North America, southward to Virginia, Ohio, and Missouri. Further west, the species occurs in the mountains as far south as Arizona. American populations are all var. *minor* Raf., with var. *trifoliata* restricted to the Old World. Steyermark (1985) considered it a northern relict species in Missouri. Northern relicts are organisms whose distributions were pushed southward during the Pleistocene Ice Age, when glaciers covered much of the northern half of North America. As these glaciers retreated, such plants and animals were forced northward again by the warming climate, but relict populations survived far to the south of the species' main range in isolated microhabitats, such as can be found in some Missouri bluffs, fens, and sinkholes.

Menyanthes trifoliata has widely creeping stems (fig. 1) and reproduces well vegetatively, but Steyermark (1963) only found flowering plants once at his site, in April 1952. Two initial visits to the new station were both made during August 1992, too late for flowering or fruiting to be easily observed. A subsequent visit by G. Yatskievych (personal communication) on 16 May 1993 disclosed only a single fertile plant, which had nearly finished flowering and was beginning to set fruit. Repeated visits will be necessary to determine whether environmental differences between years have an effect on the amount of sexual reproduction that takes place within this population. Although there are several

hundreds of stems at the site, the population may have developed primarily by means of vegetative reproduction.

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Figure 1. *Menyanthes trifoliata*. Drawing by Martha Daniels. Reprinted from Ryan (1992) with permission from the Missouri Department of Conservation.

THE *POLYGONUM AVICULARE* COMPLEX IN MISSOURI

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Polygonum (Polygonaceae) in the broad sense contains a varied assemblage of about 200 species with a worldwide distribution and greatest diversity in the temperate regions of both the Old and New Worlds. Evolutionary relationships among the several well separated subgroups of this diverse generic complex have been studied in detail during the past 25 years (Haraldsen, 1978; Hickman, 1984; Decraene and Akeroyd, 1988), with the result that some authors of floras and other taxonomic treatments are beginning to recognize various segregates as genera separate from *Polygonum sensu stricto.* Yatskievych and Turner (1990) indicated that Missouri species might fall into four genera: *Polygonum*, containing the *P. aviculare* complex and its knotweed relatives; *Fallopia*, containing the climbing buckwheats (*F. convolvulus* and *F. scandens*); *Persicaria*, containing the large group of smartweeds and tear-thumbs; and *Reynoutria*, containing the introduced Mexican bamboo (*R. japonica* [=*Polygonum cuspidatum*]). The exact number of segregates to be elevated to generic rank is still somewhat controversial, especially with regard to the limits of *Persicaria*, which has been further dissected by some authors.

At the species level, *Polygonum sensu stricto* has presented the greatest taxonomic difficulties in the complex of genera. This confusing group contains taxa native to both the Old and New Worlds, but transoceanic weedy introductions have served to confuse an under-

standing of the species numbers and distributions in various floristic areas. Infraspecific morphological variation, especially geographic and seasonal changes in leaf and fruit morphology, have tended to blur the distinctions between some of the species, and the general undercollection of particularly the weedier taxa has made it difficult to summarize the species' distributions based upon existing herbarium specimens.

HISTORY OF TAXONOMIC STUDIES

Löve and Löve (1956) were the first authors to attempt to correlate the complex polyploid variation in *Polygonum* with morphological attributes of the various segregates of *P. aviculare*, recognizing 21 species in eastern North America. Their study was flawed by some apparent misdeterminations and the paucity of herbarium specimens to voucher some of their claims (Wolf and McNeill, 1987).

Styles (1962) was the first to accurately separate *P. aviculare sensu stricto* from the widespread *P. arenastrum* in a cytological and morphological study of British populations of seven total species. Mertens and Raven (1965) extended the spirit of this research to include North American representatives, recognizing 13 native and introduced species in North America north of Mexico. More recent studies by McNeill (1981) and Wolf and McNeill (1986, 1987) have further served to clarify the cytology and taxonomy of the group in eastern North America. Excellent regional accounts have also been published for Indiana (Savage and Mertens, 1968) and New York (Mitchell and Dean, 1978), which have further helped to delineate species distributions and to focus attention on the morphological characters best suited to discrimination among the taxa.

In Missouri, the last comprehensive treatment of the group was by Steyermark (1963). He included six species of knotweeds, treating *P. achoreum*, *P. erectum*, *P. prolificum*, *P. ramosissimum*, and *P. tenue* as natives,

and some populations of *P. aviculare* (including *P. buxiforme* and *P. neglectum*) native and others apparently introduced. Yatskievych and Turner (1990) circumscribed the group in Missouri to include five native and four introduced species, based upon the literature and a preliminary examination of herbarium specimens, but did not substantiate the occurrence of taxa in the state. The present study was initiated to review the number of taxa documented to occur in Missouri and to circumscribe their ecological and geographic distributions in the state.

MATERIALS AND METHODS

Specimens collected in Missouri were examined from the following herbaria: F, MO, NEMO, SMS, UMO. Existing specimens were supplemented with new collections made by the authors and colleagues in the state and with selected non-Missouri collections housed at MO. Approximately 450 different collections, including numerous duplicates in different herbaria, were studied (Appendix 1) to evaluate the applicability of critical characters used by previous authors to discriminate among taxa of *Polygonum* elsewhere to plants growing in Missouri. Particular attention was paid to achene position and morphology, tepal morphology, and leaf length/width ratios. Character variation was compiled into concise species descriptions, based on Missouri plants.

Data from specimen labels were compiled using the dBase IIIPlus and Paradox 4.0 database packages on IBM-compatible microcomputers. Distributions and habitats were summarized from information in this database. County distributional maps were plotted directly from the database using a mapping program provided by the Missouri Department of Conservation.

RESULTS

Based on our studies, we were able to substantiate the presence of eight species of *Polygonum sensu stricto* in Missouri. These were all among the nine species accepted by Yatskievych and Turner (1990). However, no collections were found to substantiate the occurrence of *P. prolificum* in Missouri, which had been accepted by both Steyermark (1963) and Yatskievych and Turner (1990). This taxon is discussed further under *P. ramosissimum*, below.

There were numerous discrepancies between our determinations of the Missouri material and those made by earlier authors (and upon which Steyermark (1963) based his treatment). Some of the characteristics emphasized in Steyermark's (1963) key to *Polygonum* species are difficult to observe in dried material and others do not discriminate among certain taxa. This is especially true of leaf and calyx coloration and pedicel length.

There was also little concordance between the varietal names used by Steyermark (1963) and actual specimen morphologies. For example, although *P. aviculare* var. *littorale* is apparently equivalent to *P. aviculare* (Styles, 1962; Mitchell and Dean, 1978), the specimens labeled as such in the Missouri herbaria represented several different species.

The biggest problem we encountered with species concepts and specimen determinations resulted from seasonal variation of plants. Early in the growing season, some plants of otherwise prostrate species exhibit somewhat erect stems with large leaves, which are soon replaced with normal growth as the season progresses. Toward the end of the growing season, several species lose some of their leaves, giving the plants a heterophyllous appearance. Also, several species produce strongly exserted achenes toward the end of the growing season.

Collectors of knotweed specimens should preferably harvest samples late enough in the season that mature fruits are present on the plants (these will usually be mixed with flowers), and to insure that the growth pattern of the leaves (homophyllous vs. heterophyllous) can be determined. Specimens lacking fruits can be determined with difficulty by comparison of the samples with authoritatively determined specimens in herbaria. The descriptions below will provide some characters to aid in the determination of sterile or immature specimens, if growth habit (erect vs. prostrate) is noted and if sufficient leaves are present. Because some species can become rather large later in the growing season, "top-snatched" specimens of heterophyllous species may appear homophyllous. Finally, late-season collections often have lost the lower leaves, making determinations of leaf characters difficult.

TAXONOMIC SUMMARY

Polygonum L. Section Polygonum knotweeds

Polygonum L. Section *Avicularia* Meisn.

Plants taprooted, usually annuals. Stems prostrate to erect, usually much-branched, the nodes usually somewhat swollen. Leaves linear to obovate, tapering at the jointed base, sessile or with short petioles, the stipules united into a papery sheath known as an ocrea. Flowers perfect, sessile or with short pedicels, in fascicles of 1-6 in the leaf axils and (in *P. ramosissimum* and *P. tenue*) also appearing in elongate racemes. Perianth usually 5-lobed, in some species with nearly free tepals, green with white to pinkish margins or uniformly yellowish green (in *P. achoreum*), united basally, persistent in fruit. Stamens 3-8. Ovary 1 per flower, superior. Styles minute, 3, separate or partially united, the stigmas minute, capitate. Fruits achenes 2-3.5 mm long (-5 mm long in late-season achenes), ovoid, usually trigonous with flat to concave sides.

Number of species worldwide uncertain due to controversy over sectional limits, but at least 20. The greatest diversity is in temperate portions of the northern hemisphere, particularly temperate Asia (Haraldson, 1978).

KEY TO THE KNOTWEEDS OF MISSOURI

1. Leaves with 2 longitudinal folds or grooves parallel to the midvein and minutely spinulose-serrulate margins . . . . . 8. *P. tenue*
1. Leaves lacking 2 longitudinal folds or grooves parallel to the midvein, the margins entire
2. Outer 3 perianth lobes about as long as the inner 2 lobes, flat at tips or nearly so in fruits
    3. Plants heterophyllous, the leaves produced along branches of mid to late growing season less than half the length of those of main stems produced earlier in year . . . . . 3. *P. aviculare*
    3. Plants homophyllous or nearly so, the leaves showing continuous size variation during the growing season
        4. Leaves oblong to elliptic, mostly 2-4 times as long as wide; stems usually prostrate, forming mats . . . . . 2. *P. arenastrum*
        4. Leaves linear to lanceolate or narrowly oblong, mostly 5-8 times as long as wide; stems usually ascending toward the tips, forming loose mounds . . . . . 6. *P. neglectum*
2. Outer 3 perianth lobes longer than the inner 2 lobes, boat-shaped to hooded at the tips in fruits

5. Plants heterophyllous, the leaves produced along branches of mid to late growing season less than half the length of those of main stems produced earlier in year
    6. Leaves ovate to obovate, mostly 2-4 times as long as wide; surfaces of fruits striate-papillose (with close set lines of small bumps) . 5. *P. erectum*
    6. Leaves lanceolate to oblanceolate or linear, mostly 4-12 as long as wide; surfaces of fruits smooth to slightly and irregularly roughened along the angles . . . . . 7. *P. ramosissimum*
5. Plants homophyllous or nearly so, the leaves showing continuous size variation during the growing season
    7. Leaves lanceolate to oblanceolate or linear, mostly 4-12 as long as wide; surfaces of fruits smooth to slightly and irregularly roughened along the angles . . . . . 7. *P. ramosissimum*
    7. Leaves ovate to obovate, mostly 2-4 times as long as wide; surfaces of fruits finely punctate to papillose except in late-season fruits
        8. Fruiting perianth divided ca. 1/3 of its length; stems erect or spreading with age, the many branches forming dense clumps . . . . 1. *P. achoreum*

8. Fruiting perianth divided 1/2-3/4 of its length; stems prostrate, the branch tips sometimes ascending, the many branches forming mats or low mounds . . . . 4. *P. buxiforme*

1. Polygonum achoreum S.F. Blake

Stems 15-50(-70) cm long, erect or spreading with age, forming dense clumps, arising from a stout taproot, homophyllous. Leaves 10-40 mm long, the petioles to 8 mm long, bluish green, ovate to obovate, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 2.5-3.7 mm long, uniformly yellowish green, sometimes pinkish tinged, divided ca. 1/3 of its length at fruiting time, usually narrowed above the achene except in late-season fruits, the outer 3 lobes longer than the 2 inner lobes, boat-shaped to hooded at the tips, the inner 2 lobes shorter and flat, the achene enclosed or sometimes exserted. Achenes light brown to yellowish green, the surfaces finely punctate to papillose except sometimes in late-season fruits. $2n$=40, 60 (Wolf and McNeill, 1987). Flowering May to September.

Disturbed soil along roads, and edges of farm fields, and in farmyards. Widely scattered in Missouri, mostly in counties along the Missouri River (fig. 1). Apparently native, though always found in disturbed habitats. Widespread in North America from the northeastern United States and adjacent Canada west to Oregon and south to Colorado and Missouri.

Steyermark (1963) included this species based upon a single collection from Jackson County, and thought it to be introduced in the state. It was subsequently reported from three additional counties: Adair (Conrad, 1984), Grundy (Dierker, 1989), and Platte (Castaner and LaPlante, 1992; not examined during this study). The native range of *P. achoreum* is not well understood, as there is not an easily identifiable natural habitat in which this species grows. It may prove to be native to

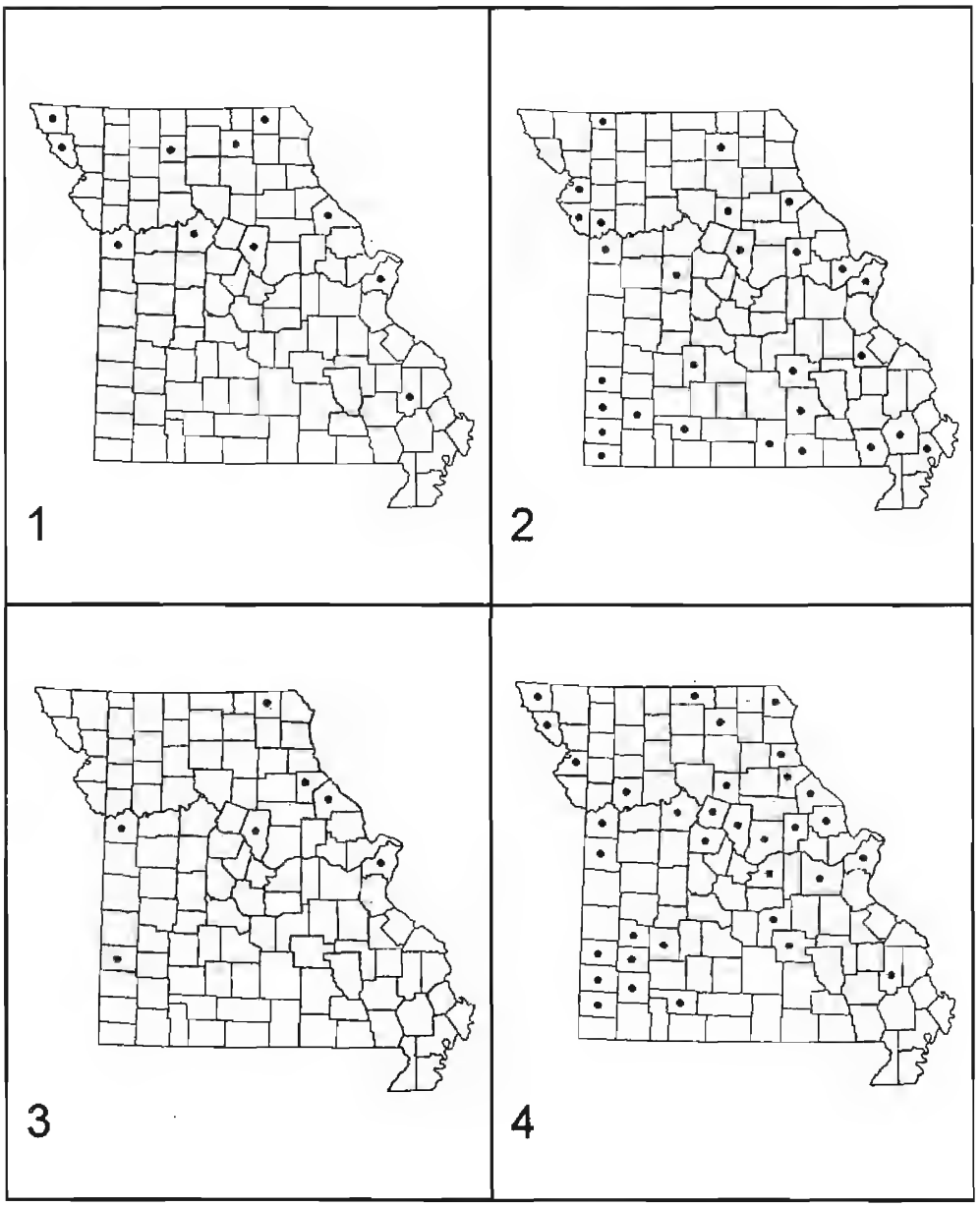

Figure 1-4. The distribution of *Polygonum* species in Missouri: 1) *P. achoreum*, 2) *P. arenastrum*, 3) *P. aviculare*, 4) *P. buxiforme*.

naturally disturbed floodplains, as has been suggested for some disturbed-soil species of *Amaranthus* in North America (Sauer, 1955). Based on the fact that this species is far more widespread in Missouri than Steyermark (1963) believed, and that it is apparently endemic to North America, we are treating it as a native species in the state.

2. Polygonum arenastrum Jord. ex Boreau

P. aviculare L. var. *arenastrum* (Boreau) Rouy

Stems 15-100 cm long, prostrate, forming mats, arising from a slender taproot, homophyllous. Leaves 4-20 mm long, the petioles to 2 mm long, bluish green, oblong to elliptic, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 1.8-2.6 mm long, green with white to pink margins, divided ca. 1/2 of its length at fruiting time, the lobes subequal, flat at the tips and often spreading, the achene enclosed or often exserted. Achenes dark brown, the surfaces finely punctate to papillose, not shiny. $2n$=40 (Mertens and Raven, 1965; Wolf and McNeill, 1987). Flowering May to October.

From cracks of sidewalks and pavement, along roads and railroads, and in lawns and waste ground. Widely scattered in Missouri (fig.2). Native to Eurasia. A nearly cosmopolitan weed, widely established in North America.

Polygonum arenastrum is far more common and widespread in Missouri than *P. aviculare*, with which it was combined by many earlier authors prior to the research of Styles (1962) and McNeill (1981), among others. It is more prevalent than the collections upon which our distributional map was based would indicate.

3. Polygonum aviculare L.

P. aviculare L. var. *angustissimum* Meisn.

P. aviculare L. var. *littorale* (Link) W.D.J. Koch

P. aviculare L. δ *vegetum* Ledeb.

Polygonum monspeliense Pers.

Stems 15-120 cm long, prostrate to ascending, less commonly erect, forming loose clumps, arising from a slender taproot, heterophyllous. Leaves of earlier stems 20-60 mm long, the petioles to 4 mm long, those of later season stems and secondary (axillary) branches 8-20 mm long, sessile or nearly so, both types green to grayish green, lanceolate to narrowly obovate, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 2.5-3.1 mm long, green with white to pink margins, divided 2/3-4/5 of its length at fruiting time, the lobes subequal, flat at the tips and usually ascending, the achene usually enclosed or only slightly exserted. Achenes dark brown, the surfaces finely punctate to papillose, not shiny. $2n$=40, 60 (Mertens and Raven, 1965; Wolf and McNeill, 1987). Flowering June to October.

Disturbed, sandy or gravelly soil along roads, lakes, and creeks, and in lawns, farmyards, and waste ground. Widely scattered and sporadic in Missouri, mostly north of the Missouri River (fig.3). Native to Eurasia. A nearly cosmopolitan weed, widely established in North America.

As noted above, many of the collections thought to represent this species are actually *P. arenastrum*, a more common, introduced weed. Steyermark (1963) discussed the controversy over whether native populations of *P. aviculare* exist in Missouri and elsewhere in North America, but the more recent refinement of our understanding of species limits and distributions has reassigned all of the putatively native Missouri collections to other taxa, such as *P. achoreum*, *P. buxiforme* and *P. ramosissimum*. McNeill (1981) and Wolf and McNeill (1986) treated the North American populations of this species as introduced, but some authors continue to suggest that it has a much broader native range. The species is now so widely distributed that the natural distribution may never be fully understood.

4. Polygonum buxiforme Small

Stems 20-70(-90) cm long, prostrate, the branch tips sometimes ascending, forming mats or low mounds, arising from a stout taproot, homophyllous. Leaves 5-37 mm long, the petioles to 5 mm long, yellowish green to bright green, sometimes grayish glaucous, narrowly ovate to obovate, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 2.0-3.1 mm long, green with white to pinkish margins divided 1/2-3/4 of its length at fruiting time, enclosing the achene except in late-season fruits, the outer 3 lobes longer than the 2 inner lobes, boat-shaped to hooded at the tips, the 2 inner lobes shorter and flat, the achene usually enclosed. Achenes light to dark brown, the surfaces finely punctate to papillose except sometimes in late-season fruits. $2n$=60 (20?, 40?) (Wolf and McNeill, 1987). Flowering May to October.

Disturbed ground along roads, railroads, farm fields, creek banks and edges of saline seeps; also in farmyards and waste ground. Widely scattered in Missouri (fig.4). Apparently native, though mostly found in disturbed habitats. Widespread in the eastern United States and adjacent Canada, south to Texas.

Steyermark (1963) placed this taxon under synonymy with *P. aviculare* var. *littorale*, but that name refers to plants with leaf and perianth features of typical *P. aviculare*, whereas *P. buxiforme* is fairly easily distinguished by characters presented in the key above.

5. Polygonum erectum L.

P. aviculare L. var. *erectum* (L.) Roth

Stems 15-45(-75) cm long, erect or sometimes spreading later in the growing season, forming dense clumps, arising from a slender taproot, heterophyllous. Leaves of main stems 18-60 mm long, the petioles to 3 mm long, those of the secondary (axillary) branches 4-10 mm long, sessile or nearly so, both types yellowish green to bright green ovate to elliptic, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 3.0-3.5

mm long, yellowish green divided 2/3-3/4 of its length at fruiting time, usually narrowed above the achene except in late-season fruits, the outer 3 lobes longer than the 2 inner lobes, boat-shaped to hooded at the tips, the inner 2 lobes shorter and flat, the achene usually enclosed. Achenes light to dark brown, the surfaces finely punctate to papillose except sometimes in late-season fruits. $2n$=40 (Savage and Mertens, 1968). Flowering June to October.

Along creeks, rivers, roadsides and paths, and in bottomland thickets and forests, lawns and farmyards. Widely scattered in Missouri, mostly in the Ozark and Ozark Border Counties (fig.5). Apparently native, though usually found in disturbed habitats. Widespread in North America.

Although this species was represented by more than 50 collections in our survey of herbarium specimens, we encountered it only rarely in the field. It is apparently not common throughout most of its range (Gleason and Cronquist, 1992). Vegetatively, it has been most frequently confused with *P. achoreum* by collectors. Aside from the characters presented in the key above, *P. erectum* may be distinguished readily by the color of the leaves, which are yellowish green to green and lack the bluish green coloration found in *P. achoreum*. Additionally, the latter species is apparently more common north of the Missouri River, whereas *P. erectum* occurs primarily in the Ozarks.

6. Polygonum neglectum Besser

Stems 10-65 cm long, prostrate, usually with the branch tips ascending, forming loose mounds, arising from a slender taproot, homophyllous. Leaves 8-30 mm long, the petioles to 3 mm long, green to bluish green, sometimes turning red in the fall, linear to lanceolate or narrowly oblong, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 2.0-3.0 mm long, green with white to pink margins, divided 1/2-3/4 of its length at fruiting time, the lobes subequal, flat at the

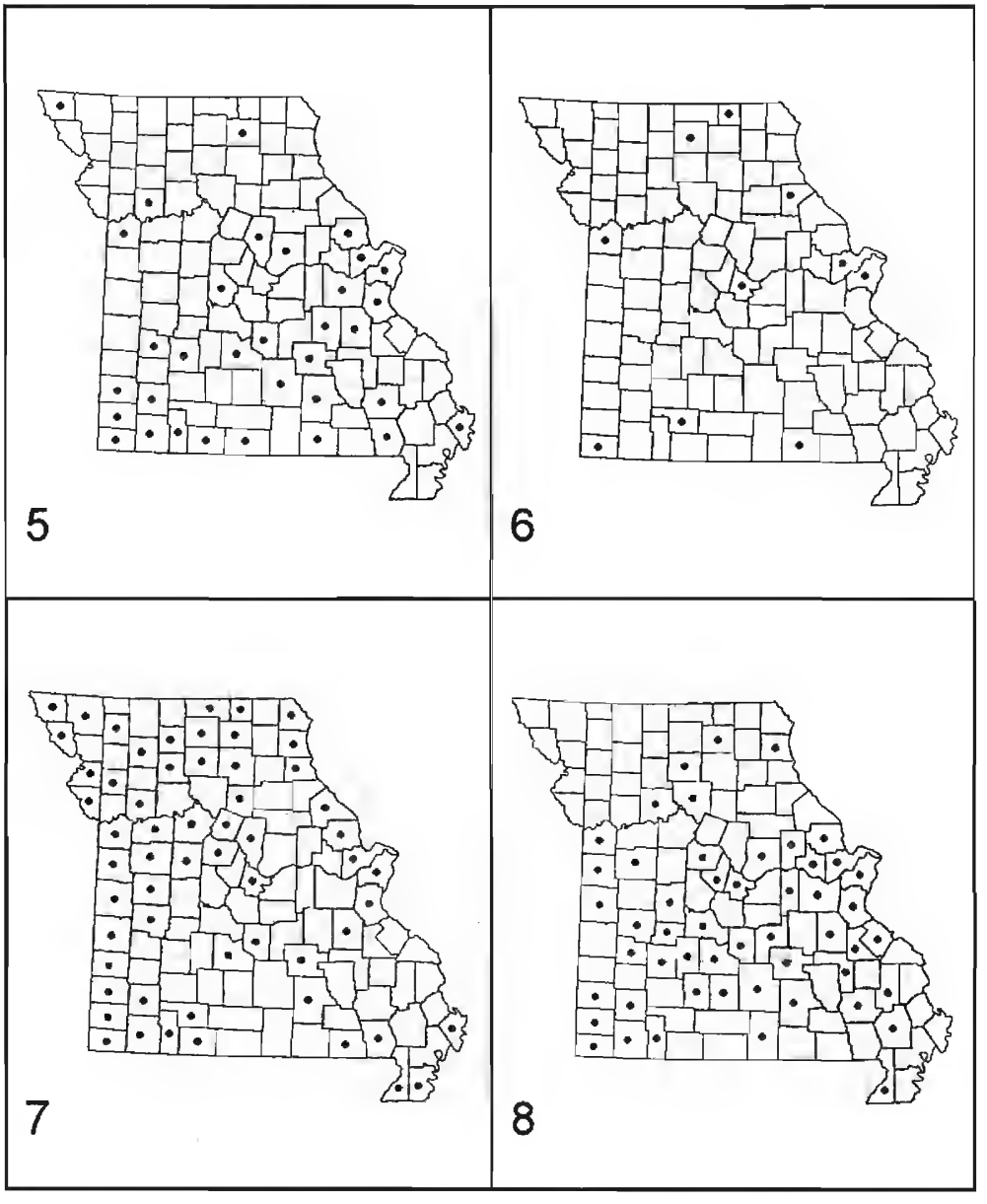

Figure 5, 6. The distribution of *Polygonum* species in Missouri: 5) *P. erectum*, 6) *P. neglectum*, 7) *P. ramosissimum*, 8) *P. tenue*.

tips or nearly so, ascending to spreading, the achene usually exserted. Achenes dark brown, the surfaces very finely punctate to papillose, not shiny. $2n$=40, 60 (Wolf and McNeill, 1987). Flowering May to September.

Disturbed soil along roads, sidewalks, and in lawns, and waste areas. Widely scattered and sporadic in Missouri (fig.6). Native to Eurasia. Widely established in the eastern and midwestern United States and adjacent Canada, west to the Rocky Mountains.

Steyermark (1963) included this taxon under the synonymy of his *P. aviculare* var. *aviculare*. It is more commonly confused with *P. arenastrum* by collectors, but differs from both of these taxa in its narrower leaves.

7. Polygonum ramosissimum Michx.

P. exsertum Small

P. ramosissimum Michx. f. *atlanticum* B.L. Rob.

P. triangulum E. Bickn.

Stems 30-170 cm long, erect or ascending, rarely spreading, not forming dense clumps, arising from a stout taproot, usually strongly heterophyllous. Leaves of main stems 15-60 mm long, the petioles to 5 mm long, those of the secondary (axillary) branches 4-10 mm long, sessile or nearly so, both types yellowish green to green or bluish green, rarely light green, often glaucous, lanceolate to oblanceolate or linear, the margins entire, lacking 2 longitudinal folds or grooves. Perianth 3.0-4.0 mm long, green to yellowish green, often with white or pink margins, divided 3/4 or more of its length at fruiting time, usually enclosing the achene except in late-season fruits, the outer 3 lobes longer than the 2 inner lobes, boat-shaped to hooded at the tips, the inner 2 lobes shorter and flat, the achene enclosed or often exserted. Achenes brown, sometimes pale tan to yellowish green in late season fruits, the surfaces smooth and more-or-less shiny except sometimes slightly and irregularly roughened along the angles. Late season fruits sometimes appearing biconvex rather than

trigonous. $2n$=20, 60 (Löve and Löve, 1956; Wolf and McNeill, 1987). Flowering May to October.

Wet prairies, marshes; saline seeps, wet ground along rivers, streams, lakes, open edges of swamps, and low thickets, and along roadsides; less common in drier, disturbed areas, in bottomland forests, along levees, and in sand prairies. Widespread in Missouri (fig.7). Native. Widespread in North America, west to New Mexico; apparently introduced in northern California.

Steyermark (1963) and Yatskievych and Turner (1990) included *P. prolificum* (Small) B.L. Rob. for Missouri, based on collections from disturbed areas in the Missouri River floodplain in Clay and Jackson Counties (see Steyermark, 1963, p. 384). These collections were redetermined as typical *P. ramosissimum* during the course of the present study. Likewise, vouchers for Henderson's (1980) report of this taxon for Lawrence County and Solecki's (1984) report for Vernon County were redetermined as *P. ramosissimum*. A report by Ohmart (1987) for Scott County was not investigated, but is also presumably misdetermined.

Two apparent ecotypes of *P. ramosissimum* in Missouri that display some characteristics of *P. prolificum* are worthy of note. Occasional collections from Jasper, Shannon, and Taney Counties represent a morphotype that has flowers with very short pedicels as in the latter taxon, but have the acute to acuminate leaves and tendency toward a heterophyllous growth form more typical of the former species. The authors' field experience suggests that these represent short-pedicellate individuals within populations of otherwise "normal" plants of *P. ramosissimum*.

A second, unusual morphotype consists of highly colonial plants with relatively fleshy, light green leaves that tend to be obtuse at the apices, but which have pedicels longer than in typical *P. prolificum*. These plants are confined to salt seeps in Cooper, Howard and Saline Counties, where the colonies grow in hypersaline, shallow water supporting few other vascular plant

species. Steyermark (1963) mistakenly treated thesepopulations as a native strain of the introduced *P. avic-ulare*. Although these plants appear somewhat different from other Missouri material, they seem to fit within the variation exhibited by the species elsewhere in its distributional range, particularly in brackish, coastal areas. It may be that these particular populations represent a separate introduction into Missouri of plants from elsewhere in the species range. Taxonomically, they appear unworthy of separation at the varietal or species levels.

Polygonum prolificum is a taxon whose taxonomic distinction from *P. ramosissimum* remains controversial. Although most botanists consider the two separate species, some authors treat *P. prolificum* as a variety of the latter (*P. ramosissimum* var. *prolificum* Small; cf. Mitchell and Dean, 1978), and a few workers suggest that it might be unworthy of any taxonomic segregation (Kaul, 1986). This situation requires further study rangewide. Whatever the outcome, however, true *P. prolificum* apparently does not occur in Missouri.

8. Polygonum tenue Michx.

Stems 15-45 cm long, erect or strongly ascending, arising from a slender taproot, homophyllous. Leaves 5-40 mm long, the petioles to 2 mm long, green to pale green, turning orange in the fall, linear to narrowly lanceolate, minutely spinulose-serrulate along the margins, with 2 longitudinal folds or grooves parallel to the midvein. Perianth 2.6-4.2 mm long, green with white to pink margins, divided 4/5 or more of its length at fruiting time, the outer 3 lobes longer than the 2 inner lobes, boat-shaped at the tips and often spreading, the inner 2 lobes shorter and flat, the achene enclosed or often exserted. Achenes dark brown, the surfaces finely punctate to papillose, not shiny. $2n$=20, 30, 32. Flowering July to October.

Open, dry, sandy or rocky soil, on chert, sandstone, and igneous glades, less commonly on cherty portions of

dolomite glades, shale glades, rocky, open, upland forests, or sand and gravel bars of intermittent streams; also in sand blowouts, in sandy waste ground, and along railroad tracks. Widespread in Missouri, though mostly south of the Missouri River (fig.8). Native. Widespread in North America, west to New Mexico.

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APPENDIX 1.
INDEX TO MISSOURI EXSICCATAE

(1) *Polygonum achoreum* S.F. Blake
(2) *Polygonum arenastrum* Jord. ex Boreau
(3) *Polygonum aviculare* L.
(4) *Polygonum buxiforme* Small
(5) *Polygonum erectum* L.
(6) *Polygonum neglectum* Besser
(7) *Polygonum ramosissimum* Michx.
(8) *Polygonum tenue* Michx.

Anderson, C. MO102 (2)
Bauer, B. 128 (6); 158 (7); 383 (7); 919 (5); 1046A (7)
Bell, M.E. on 1 Aug 1958 (4); on 20 July 1959 (4)
Blankinship, J.W. 2156 (8)
Boehm, R. in 1901 (2)
Bohn, W. on 8 June 1932 (2)
Bojannsky, V. NA-69-38 (1); NA-69-39 (2)
Brant, A.E. 2157 (2); 2192 (2); 2192A (4); 2218 (4); 2218A (1); 2151 (3)
Brant, A.E. & A.F. O'Donnell 2133 (2); 2216 (3); 2217 (1); 2219 (2); 2220 (3); 2249 (2); 2250 (7); 2251 (2)
Brant, A.E., B. Holst, & F. Lorea 2136 (2)
Brant, A.E. & M. Pelton 2137 (1); 2138 (2)
Brant, A.E. & G., I., & D. Carnevali 1921 (8)
Brower, A. E. 1311 (2)
Burchcord, J. on 4 Oct 1938 (4)
Bush, B.F. 2 (7); 241 (7); 329 (7); 402 (5); 404 (7); 434 (7); F. 503 (4); 509 (8); 510 (7); 2154 (8); 2155 (8); 3263 (8); 4060 (1); 4095 (4); 5067 (8); 7069A (4); 7074 (5); 7081 (7); 7156 (6); 8041 (7); 8371 (7); 9600A (7); 11353 (7); 11647 (4); 11797 (3); 12128 (2); 12506 (2); 14920 (8); 15135 (8); 15941 (7); 72507 (2); on 5 Sep 1884 (7); on 16 Aug 1891 (4); on 16 Aug 1891 (7); on 3 Sep 1892 (7); on 28 Sep 1892 (5); on 8 Aug 1893 (5); on 16 Aug 1893 (8); on 1 Sep 1893 (8); on 10 Sep 1893 (8); on 11 Sep 1893 (7); on 12 Sep 1893 (8); on 11 Oct 1893 (7)

Christ, A. on 21 June 1930 (3); on 19 Sep 1969; on 10 Sep 1971 (5); on 18 July 1985 (7); on 11 June 1986 (5); on 17 Aug 1987 (7)
Comte, F. 515 (2); 1846 (8); 4912 (2)
Conrad, M.L. 4299 (4); 11451 (6)
Conrad, M.L., J.E. Dimit, & R.L. Walker 8259 (7); 8440 (2)
Craig, M. on 14 Aug 1910 (7)
Croat, T.B. 69790 (8)
D'Arcy, W.G. 3510 (2); on 13 July 1969 (2)
Daniels, F. in July 1903 (4);in Aug 1902 (5)
Daniels, J. P in May 1897 (2)
Davis, D. on 5 June 1940 (7)
Davis, Rev. J. 3525 (7); 8109 (4); 9067 (6); 9091 (4)
Delozier, P. 1938 (6); 1627 (3)
Dewart, F.W. 75 (4)
Dierker, W.W. 01492 (1)
Drouet, F. 250 (2); 636 (7); 637 (4); 900 (2); 960 (5); F. 993 (3); 1002 (4); 1003 (2); 1006 (7);1015 (2); 1059 (7); 1092 (7); 1120 (5); 1226 (5); 1264 (4); 1719 (7); 1780 (4); 1786 (7); 3102 (7)
Drushel, J.A. on 25 Aug 1918 (8)
Dunn, D. B. 12718 (2)
Eggert, H. on 18 Sep 1892 (5); on 27 Sep 1893 (8); on 9 Sep 1896 (8)
Engelmann, G. in July 1838 (2); in July 1838 (4); in Sep 1838 (5); in Oct 1845 (7); in Sep 1875 (7)
Etter, A.G. 47-198 (3)
Favor, E.H. on 16 July 19010716 (2); on 29 Aug 1901 (3)
Gallian, P. 125 (3)
Gereau, R.E. & A.E. Brant 1816 (2); 2356 (2)
Geyer, C. in 1837 (7)
Glatfelter, N. M. in Oct 1891 (7)
Gleason, Y.M. 200 (7); 328 (6)
Greenman J.M., R. Hoffman on 7 Sep 1918 (6)
Grime, W. E. 723 (2)
Henderson, N.C. 65-372 (2); 65-495 (2); 65-495 (4); 65-545 (7); 67-1634 (7); 67-1799 (2); 67-879 (4); 68-691 (2); 89-04 (7)
Holtzeu, Dr., E.E. on 29 Aug 1940 (2)
Hornberger, K.L. 892 (5)
Hudson, S. 233 (2); 234 (2)
Johnson, W. on 4 Oct 1938 (4)
Kellogg, J.H. 154 (4); 193 (4); 875 (4); 878 (8); 1703 (8); 15172 (8); 26100 (7); in Aug 1886 (8); on 19 Sep 1897 (8); on 28 Aug1922 (2); on 10 July 1927 (8); on 1 Oct 1927 (4); on 9 Oct 1927 (4); on 20 Sep 1930 (7); on 15 Oct 1930 (4); on 16 Sep 1931 (2); on 16 Sep 1931 (4); on 16 Sep 1931 (7); on 18 Aug 1932 (2); on 18 Aug 1932 (6); on 18 Aug 1932 (7); on 22 Sep 1932 (4); on 22 Sep 1932 (8); on 3 Oct 1932 (5); on 18 July 1933 (4); on 19 Sep 1933 (7); on 9 Sep 1934 (4); on 24 Sep 1937 (8)
Key, D.P. 146 (2)

Kramer, K. & G. Gremaud on 10 Sep 1991 (7)
Ladd, D. 5121 (2); 9658 (5); 16747 (4)
Letterman, G.W. 2 (5); 3 (7); on 10 Aug 1893 (2); without date (8)
Mackenzie, K.K. 379 (7); on 28 Sep 1895 (7)
Maneval, K. on 30 July 1927 (3)
Mason, J.M. on 25 June 1938 (4)
Mathias, M. 999 (3)
Maupin, G.T. 924 (7); 1164 (2)
Millett, S. 6 (7)
Mohlenbrock, R. 10135 (8)
Niewald, R. 13 (2)
Norton, J.B.S. on 14 June 1900 (4)
Ovrebo, R.T. & C.M. Sladewski WO927 (7)
Palmer, E.J. 252 (7); 894 (5). 1427 (8); 1529 (8); 1540 (7); 2673 (8); 2847 (8); 16052 (4); 16164 (7); 16176 (7); 16246 (7); 19171 (7); 19176 (5); 20445 (7); 24078 (4); 26276 (2); 32206 (5); 32215 (7); 50632 (2); 51371 (7); 52349 (2); 52473 (4); 52719 (4); 53232 (2); 54428 (7); 54776 (5); 54777 (2); 54811 (7); 54977 (7); 55049 (5); 56115 (7); 56499 (7); 56678 (7); 56756 (7); 56761 (7); 56814 (4); 56959 (4); 57137 (4); 57755 (5); 57948 (7); 58106 (4); 58107 (4); 58167 (4); 58885 (2); 58989 (4); 60600 (6); 60601 (4); 60656 (7); 60758-A (7); 60780-A (3); 60866 (5); 60866 (7); 61260 (7); 61789 (2); 65250 (4); 65761 (7); 65999 (4); 66080 (4); 66222 (7); 66281 (7); 66718 (4); 67050 (7); 67068 (7); 67141 (7); 67142 (4); 68659 (7); 68928 (2); 68970 (4); 69141 (7); 69297 (2); on 6 Sep 1903 (7)
Peterson, J. on 23 June 1971 (1)
Redfearn, P.L., G. Pyrah, L.E. Milliger, & J. T. Witherspoon 1464 (5)
Redfearn, P.L., G. Pyrah, W. Weber, & J.T. Witherspoon 1779 (2); 1782 (5)
Redfearn, P.L., G. Pyrah, W. Weber, J.T. Witherspoon, & L.E. Milliger 1089 (5)
Reese, G. 1688 (7)
Rickett, H.W. on 30 July 1927 (4); on 28 June 1929 (4); on 28 June 1929 (5); on 27 July 1929 (4)
Smith, T.E. 2651 (8); 2800 (8)
Solecki, M.K. 999 (7); 1006 (7)
Steyermark, J.A. 1324 (8); 1336 (4); 1337 (5) 1891 (5); 4371 (5); 5379 (5); 5405 (6); 5819 (4); 5859 (7); 6188 (8); 7447 (7); 7467 (7); 8091 (7); 8588 (8); 8636 (5); 8754 (7); 8941 (7); 9057 (7); 9414 (7); 9612 (7); 9917 (7); 9997 (7); 11263 (5); 11766 (8); 13499 (4); 13500 (5); 13644 (8); 13671 (8); 14102 (8); 14793 (4); 14794 (4); 14795 (7); 14805 (7); 14808 (7); 14822 (7); 14869 (7); 14935 (7); 15101 (7); 15214 (7); 15229 (7); 15252 (7); 15650 (8); 15751 (8); 15807 (8); 15884 (8); 15913 (4); 15913 (7); 15921 (7); 16039 (4); 16044 (7); 16053 (7); 16100 (7); 19499 (8); 19924 (8); 20199 (8); 20559 (5); 21318 (8); 21579 (4); 21580 (4); 21583 (7); 22708 (7);

23819 (8); 23984 (8); 24124 (5); 24415 (7); 24453 (8); 24483 (8); 24586 (8); 24634 (7); 24667 (7); 24837 (8); 24887 (8); 24936 (7); 25002 (8); 25023 (8); 25201 (8); 25386 (8); 25456 (8); 25687 (8); 26031 (5); 26154 (8); 26262 (7); 26423 (8); 40390 (8); 66292 (5); 66680 (5); 66685 (7); 66730 (7); 66733 (7); 68723 (7); 68840 (7); 68861 (7); 70083 (7); 70250 (4); 70290 (7); 72418 (4); 72535 (5); 76440 (5); 76447 (7); 77206 (7); 77335 (7); 77793 (5); 77869 (8); 77874 (7); 79097 (7); 79188 (4); 79380 (7); 79507 (7); 79507 (7); 79708 (4); 79783 (7); 79828 (7); 79962 (7); 80167 (7); 80197 (7); 80657 (7); 80760 (7); 82062 (5); 82086 (5); 82543 (7); 82808 (7); 83078 (4)

Summers, B. 374 (8); 1475 (5); 799 (8); 1497 (5); 1560 (5); 1574 (8); 1901 (2); 1902 (2); 5195 (7); 5446 (5); 5506 (2); 5507 (5); 6530 (2)

Summers, B. & C. Dodds 5305 (1); 5305A (4); 5425 (5)

Thieret, J.W. 1745 (7)

Toney, T. & L.S. Korschgen on 6 Sep 1978 (1)

Trelease, W. 763 (8); 766 (4); 1171 (8); on 31 July 1895 (6)

Van Horn, M. in 1925 (2)

Vincent, M.A. 4403 (6)

Walker, R.L. 166 (8); 530 (7)

Wislizenus, F. 365 (7)

Woodson Jr., R.E. 878 (7)

Yatskievych, G. & K. 89-344 (8); 91-155 (4); 91-171 (2); 91-171A (6); 92-281 (6)

Yatskievych, G., A. Bornstein, P. McKenzie, D. Newman, M. McGarry 93-339 (8)

Yatskievych, G. & K., & J. Harris 92-299 (4)

Yatskievych, G., & B. Summers 93-197 (4); 93-198 (1)

Yatskievych, G., B. Summers, K. Kramer, & R. Thorn 93-154 (1)

Yatskievych, G., B. Summers, & P. McKenzie 93-114 (7); 93-123 (1)

Yatskievych, G., B. Summers 93-170 (4)

Yatskievych, G. & K., J. & J. Turner, & B. Nellums 90-384 (8)